TITLE OF THE INVENTION

RADIOGRAPHIC APPARATUS

FIELD OF THE INVENTION

5   The present invention relates to radiography of an object.

BACKGROUND OF THE INVENTION

        Methods of irradiating a subject with radiation
10   and detecting the intensity distribution of the radiation transmitted through the subject to obtain the radiographic image of the subject are widely generally used in the fields of industrial nondestructive inspection and medical diagnosis. A detailed example
15   of the general method of obtaining the radiographic image of a subject is a method that combines a silver halide film and a so-called "phosphor screen" (or intensifying screen) which emits fluorescence upon receiving radiation. In this method, a subject is
20   irradiated with radiation. The radiation transmitted through the subject is converted into visible light by the phosphor screen to form a latent image on the silver halide film. After that, the silver halide film is chemically processed to obtain a visible image. A
25   radiographic image obtained by this method is an analog radiograph which is used for diagnosis or inspection.

        Computed radiography apparatuses (to be referred

to as CR apparatuses hereinafter) which use an imaging plate (to be referred to as an IP hereinafter) having a stimulable phosphor layer are also becoming popular. When an IP is primarily excited by radiation

5   irradiation and then secondarily excited by visible light such as a red laser beam, stimulable phosphorescence is generated. In the CR apparatus, the light emission is detected by a photosensor such as a photomultiplier to acquire a radiographic image. On

10   the basis of this image data, a visible light image is output to a photographic sensitive material or CRT. The CR apparatus is a digital apparatus. However, since the read by secondary excitation, i.e., an image formation process is necessary, the CR apparatus is an

15   indirect digital radiographic apparatus. The CR apparatus is an indirect radiographic apparatus because the radiographed image cannot immediately be displayed, as in the analog technology.

On the other hand, a technique for acquiring a

20   digital image has recently been developed in which a photoelectric conversion device having pixels each comprising a small photoelectric conversion element and switching element arrayed in a matrix is used as a reception means. An image sensing apparatus based on

25   this technique is a direct digital image sensing apparatus because it can immediately display acquired image data.

Advantages of the digital image sensing apparatus, which cannot be obtained in the analog photographic technique, are a filmless operation, effective utilization of acquired information by image

5   processing, and database formation. There is also an advantage that image data can immediately be acquired and displayed. An indirect radiographic apparatus requires an image formation process such as secondary excitation. A direct radiographic apparatus however

10   can convert a radiographic image into digital data immediately after image sensing. An indirect radiographic apparatus requires a separate read apparatus for secondary excitation. However, a direct radiographic apparatus requires no separate read

15   apparatus.

In the conventional image sensing apparatus using a silver halide film, overexposure or underexposure readily occurs because the dynamic range for a radiation irradiation dose is narrow. To stabilize

20   this, an automatic exposion control circuit (AEC (Automatic Exposion Control) circuit) called a phototimer is used. Radiation detection elements are arranged in front of or behind the film. The outputs from the radiation detection elements are integrated.

25   The integrated value is compared with a predetermined set value so as to obtain a photographic density necessary for diagnosis. When the integrated value

reaches the set value, the AEC circuit transmits an
X-ray cutoff signal to an X-ray generation device to
cut off X-ray irradiation.

A digital image sensing apparatus has a wider
5   dynamic range than that in the conventional radiography
using silver halide films. The tolerance for
overexposure or underexposure is larger than in the
radiography using silver halide films. Even when the
arrival radiation dose is inappropriate, an image
10   output suitable for diagnosis can be obtained by image
processing such as density conversion.

However, when the arrival radiation dose becomes
at low level, the effect of quantization noise or
system noise of the apparatus becomes large, and the
15   S/N ratio of the image decreases. Hence, even a
digital image sensing apparatus uses an AEC circuit,
like the radiography using silver halide films, in
order to obtain a minimum arrival radiation dose to
ensure the quality of an acquired image. A digital
20   image sensing apparatus to which such an AEC circuit is
applied is disclosed in, e.g., Japanese Patent
Laid-Open No. 11-151233.

As described above, even in an image sensing
apparatus which uses an image sensing section (also
25   called a flat panel detector (FPD)) including
solid-state photodetection elements, conventionally,
AEC radiation detection elements separate from the FPD

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are arranged in front of the FPD, and an AEC circuit is operated. However, it is becoming possible to arrange the AEC radiation detection elements inside the FPD in order to meet requirements for compact and simple image

5 sensing apparatuses, cost reduction, and advanced manufacturing techniques.

When the shape of the FPD is, e.g., rectangular (e.g., a 14" $\times$ 17" size), like a conventional film, radiographing is executed while the direction of the

10 FPD (the direction of the FPD can be grasped as, e.g., the direction of the long side or short side or portrait or landscape) is set in accordance with the object (e.g., the body part to be radiographed or the physique) to be radiographed. If the FPD arrangement

15 has a degree of freedom, the arrangement of the AEC radiation detection elements in the FPD is not always optimum for radiographing. In some cases, no high-quality subject image can be obtained.

More specifically, in, e.g., a stereoscopic

20 radiography apparatus, assume that the arrangement of the AEC radiation detection elements is optimum when the FPD is set in a vertical mode (an arrangement in which the long side is set in the vertical direction; also called a portrait mode). In this case, if the FPD

25 is set in a horizontal mode (an arrangement in which the long side is set in the horizontal direction; also called a landscape mode), the AEC radiation detection

elements are arranged at positions that are not optimum. Even in an apparatus which has an FPD and AEC radiation detection elements separate from the FPD, when the FPD and AEC radiation detection elements are

5   integrally pivoted, the above-described problem is posed.

                    SUMMARY OF THE INVENTION

         The present invention has been made in

10 consideration of the above-described problem, and has as its object to, e.g., make it possible to appropriately execute automatic exposion control.

         According to the present invention, there is provided a radiographic apparatus having a radiographic

15 image detection section which detects a radiographic image of an object and a plurality of radiation dose detection sections which detect a dose of radiation from the object, comprising a control section which decides a mode of use of outputs from the plurality of

20 radiation dose detection sections on the basis of a relative positional relationship between the object and the radiographic apparatus (e.g., the arrangement state of the radiographic apparatus).

         Other features and advantages of the present

25 invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate

the same or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

5   The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

10   Fig. 1 is an equivalent circuit diagram of a photodetection pixel of a radiographic apparatus according to an embodiment of the present invention;

Fig. 2 is a schematic view of an FPD (Flat Panel Detector);

15   Fig. 3 is a schematic view of the radiation detection section of the FPD to which AEC (Auto Exposure Control) radiation detection pixels are applied;

Figs. 4A and 4B are views showing the layout of

20 AEC detection regions;

Figs. 5A and 5B are views showing the layout of AEC detection regions;

Fig. 6 is a block diagram of the control system of the radiographic apparatus;

25   Fig. 7 is a flow chart showing the flow of processing of the control section; and

Fig. 8 is a block diagram of a computer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A radiographic apparatus according to an embodiment of the present invention will be described

5   next with reference to the accompanying drawings.

The structure of the radiographic apparatus according to this embodiment will be described first. A description will be done below by using an example in which a flat panel detector (FPD) is applied to a

10   radiographic apparatus.

The schematic arrangement of the FPD will be described. The FPD is constituted by a scintillator, photodetection pixel array, and driving circuit. In the scintillator, the matrix substance of the phosphor

15   is excited by incident radiation, and fluorescence in a visible range is obtained. Fluorescence obtained by this scintillator is generated by the matrix itself such as $CaWO_4$ or $CdWO_4$ or by a luminescent center substance such as CsI : Tl or ZnS : Ag, which is

20   activated in the matrix.

Photodetection pixels are arranged in a matrix adjacent to the scintillator. The array of photodetection pixels arranged in a matrix converts photons obtained by the scintillator into an electrical

25   signal. Fig. 1 is an equivalent circuit diagram of one pixel of the photodetection pixel array.

In the following example, a two-dimensional

amorphous silicon sensor is used. However, the detection element is not limited to this. For example, any other solid-state image sensing element may be used.

5   A photodetection pixel 100 has a photodetection element 21 which detects incident light and a switching TFT 22 which controls accumulation and read of charges. The photodetection pixel 100 is generally formed from amorphous silicon (a-Si) formed on a glass substrate.

10 The photodetection element 21 has a capacitor 21C and photodiode 21D. The capacitor 21C may be either simply the parasitic capacitance of the photodiode 21D or a capacitor which is formed parallel to the photodiode 21D so as to improve the dynamic range of the

15 photodetection pixel 100.

      An anode A of the photodetection element 21 is connected to a bias line Lb serving as a common electrode. A cathode K of the photodetection element 21 is connected to the switching TFT 22 which can

20 freely be controlled to read out charges accumulated in the capacitor 21C. In this embodiment, the switching TFT 22 is a thin-film transistor connected between the cathode K of the photodetection element 21 and an amplifier 26 for the charge read.

25   After the switching TFT 22 and a reset switch 25 are operated to reset the capacitor 21C, the pixel is irradiated with radiation 1. Accordingly, charges

generated by the photodiode 21D in correspondence with the dose of the radiation 1 are accumulated in the capacitor 21C. When the switching TFT 22 is operated again, the signal charges accumulated in the capacitor

5   21C are transferred to a capacitive element 23. The charge amount accumulated by the photodiode 21D is read through the amplifier 26. When the readout signal is A/D-converted, the dose of incident radiation is detected.

10   Fig. 2 is a schematic view of a radiographic apparatus having a radiographic image detection section 8 in which the photodetection pixels 100 are arrayed in a matrix.

         Normally, a photodetection pixel array is

15   constituted by about 2,000 $\times$ 2,000 to 4,000 $\times$ 4,000 pixels. The area of the array is about 200 mm $\times$ 200 mm to 500 mm $\times$ 500 mm. In the example shown in Fig. 2, the photodetection pixel array is constituted by 3,328 $\times$ 4,096 pixels. The area of the photodetection pixel

20   array is 350 mm $\times$ 430 mm. The size per pixel is about 105 μm $\times$ 105 μm. In the radiographic image detection section 8, 3,328 pixels are arrayed in the row direction, and 4,096 pixels are arrayed in the column direction. The pixels are two-dimensionally arranged.

25   As described above, one pixel has the photodetection element 21 and switching TFT 22. Reference numerals 21(1,1) to 21(3328,4096) indicate

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the photodetection elements 21. The cathode side of
the photodiode 21D is indicated by K, and the anode
side is indicated by A. Reference numerals 22(1,1) to
22(3328,4096) indicate the switching TFTs 22.

5   The K electrodes of photodetection elements
21(m,n) of each column of the two-dimensional
photodetection pixel array are connected to a
corresponding one of column signal lines L_c1 to L_c3328,
which are common to the respective columns, through the
10   source and drain conductive paths of corresponding
switching TFTs 22(m,n). For example, the
photodetection elements 21(1,1) to 21(1,4096) of column
1 are connected to the first column signal line L_c1. On
the other hand, the A electrodes of photodetection
15   elements 21 of each row are connected to a bias power
supply 31 through the common bias line Lb. The gate
electrodes of the switching TFTs 22 of each row are
connected to a corresponding one of row selection lines
L_r1 to L_r4096. For example, the switching TFTs 22(1,1)
20   to 22(3328,1) of row 1 are connected to the row
selection line L_r1.

       Row selection lines L_r are connected to a driving
control section (not shown) through a line selector
section 32. The line selector section 32 is formed
25   from, e.g., an address decoder 34 and 4,096 switch
elements 35. With this arrangement, a signal can
selectively be read from an arbitrary row. The line

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selector section 32 can easily be constituted by using a shift register that is used for, e.g., a liquid crystal display.

Column signal lines L_c are connected to a signal

5   read section 36 which is controlled by a driving control section (not shown). The signal read section 36 has a reset reference power supply 24, the reset switches 25 which reset the column signal lines L_c to the reference potential of the reset reference power

10   supply 24, the preamplifiers 26 which amplify the signal potentials, sample-and-hold circuits 38, an analog multiplexer 39, and an A/D converter 40. The signals from the respective column signal lines $L_c n$ are amplified by the preamplifiers 26 and held by the

15   sample-and-hold circuits 38. The output signals are sequentially output to the A/D converter 40 through the analog multiplexer 39 and converted into digital values.

In the photoelectric conversion device of this

20   embodiment, the $3,328 \times 4,096$ pixels are distributed to the 3,328 column signal lines $L_c n$ so that signals from 3,328 pixels per row are simultaneously output. The output signals are sequentially converted into digital signals by the A/D converter 40 through the

25   column signal lines L_c, preamplifiers 26(1 to 3328), the sample-and-hold sections 38(1 to 3328), and analog multiplexer 39.

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The arrangement shown in Fig. 2 is illustrated as if it were constituted by one A/D converter 40. Actually, A/D conversion can simultaneously be executed by, e.g., four to 32 systems. This arrangement is

5   employed in order to shorten the image signal read time without increasing the analog signal band and A/D conversion rate.

Fig. 3 is a schematic view of the radiographic image detection section 8 including AEC (Auto Exposure

10   Control) detection elements 50. For the sake of simplicity, Fig. 3 shows only 3 × 3 pixels of a number of photodetection pixels 100 of the radiographic image detection section 8.

As shown in Fig. 3, the AEC detection elements 50

15   which are prepared to adjust the dose of radiation incident on the photodetection pixel array having the above-described structure are connected to a bias power supply (Bias2) that applies a bias and an amplifier (Amp2) that amplifies an output signal. The circuit of

20   the AEC detection elements 50 is separated from the array of the photodetection pixels 100 and arranged in the gap between the pixels of the photodetection pixel array.

In a general photodetection pixel array, lines

25   run in the row and column directions. In addition, to increase the opening ratio, regions except the switching TFTs 22 of the pixels are occupied by the

opening portions of the photodiodes 21D as much as possible. Hence, no gap where the AEC detection elements can be arranged is present between the pixels.

In an embodiment, to form the AEC detection
5   elements 50 on the photodetection pixel array, the opening regions of some photodetection pixels are made small. The AEC detection elements 50 are formed in the unoccupied region. In the remaining embodiments, the photodiodes 21D may completely be removed while leaving
10   the switching TFTs 22 such that the AEC detection elements 50 can be formed in the unoccupied region. In the latter case, since an image partially lacks pixel data, pixel interpolation processing must be executed for the output digital image data.

15   The radiation dose detection section may be formed in a layer different from that of the pixels of the radiographic image detection section.

Generally, it is not enough that AEC detection regions corresponding to several pixels or one line are
20   simply formed on the two-dimensional photodetection pixel array. When, e.g., radiographing a chest part of a human body, a conventional AEC device represented by a phototimer is designed to measure the dose of radiation transmitted through the pulmonary part and
25   cut off radiation irradiation when the dose reaches a predetermined value.

Assume that an AEC detection element having a

size almost corresponding to one pixel is formed on an FPD. In this case, if the formed AEC detection element is located at a position corresponding to the pulmonary part of the patient, no problem is posed. However, if

5   the AEC detection element is not located at a position corresponding to the pulmonary part because of the difference in physique or internal structure of the patient or misalignment at the time of radiographing, the AEC detection element is arranged at, e.g., a

10   portion where the transit dose is smaller. As a result, radiation irradiation is executed more than expected, and AEC cannot be useful.

This problem can be solved by forming the AEC detection elements 50 not in a dot-like region

15   corresponding to one pixel but a region that is long to some extent in both the row and column directions. More specifically, for example, like a phototimer, the AEC detection elements 50 are formed in a rectangular region with a size of about 50 mm $\times$ 50 mm. The AEC

20   detection elements 50 need not be formed in the entire region. For example, when one pixel of the photodetection pixel array has a size of 105 μm $\times$ 105 μm, an AEC detection region can be formed by arranging six groups of AEC detection elements 50 that are

25   arranged in a line in correspondence with 500 pixels in the column direction, as shown in Fig. 3, every 100 pixels in the row direction.

Radiographing using an FPD having above-described

AEC detection regions 51 will be described next.

The AEC detection regions 51 formed on the FPD

can be arranged to radiograph a chest part and belly

5   part, like a phototimer. Assume that the AEC detection

regions 51 are arranged, as shown in Fig. 4A, in the

region of the radiographic image detection section 8 of

an FPD having a 14" × 17" size. Fig. 4A shows an

example in which the AEC detection regions 51 are

10   arranged on the FPD assuming chest/belly part

radiographing in a 14" × 17" size portrait mode, and

radiographing is executed while setting the FPD in the

vertical direction (portrait). Depending on the

physique of the patient, radiographing needs to be

15   executed while setting the FPD in the horizontal

direction. In radiographing in a 14" × 17" size

landscape mode, the AEC detection regions 51 in the

region of the radiographic image detection section 8 of

the FPD are located at positions shown in Fig. 4B. In

20   this case, the positions of the AEC detection regions

51 are not appropriate at all for controlling the

transit dose of a pulmonary part or the like. AEC can

hardly be useful.

In the radiographic apparatus according to the

25   embodiment of the present invention, as shown in

Figs. 5A and 5B, the AEC detection regions 51 (also

called radiation dose detection sections) are arranged

at at least four portions in the region of the

radiographic image detection section 8. Fig. 5A shows

the layout when the FPD having a 14" × 17" size is set

in the vertical direction (portrait). Fig. 5B shows

5   the layout when the FPD having a 14" × 17" size is set

in the horizontal direction (landscape). For at least

four AEC detection regions 51, a first AEC detection

region 51a is formed almost at the center (the

intersection between two diagonals) of the FPD.

10   Remaining AEC detection regions 51b are arranged at

positions almost equidistant from the first AEC

detection region 51a. Of the plurality of AEC

detection regions 51b, two arbitrary AEC detection

regions 51b adjacent to each other are arranged to be

15   symmetrical about a straight line that passes through

the center of the FPD and runs parallel to the long or

short side of the FPD.

In the examples shown in Figs. 5A and 5B, assume

a square whose side has a length almost corresponding

20   to the interval between the left and right pulmonary

parts (the center of the square is located almost at

the center of the FPD, and one side of the square is

almost parallel to one side of the radiographic image

detection section 8). In this case, the AEC detection

25   regions 51 (radiation dose detection sections) are

arranged at the center and three vertices of the

square. The radiation dose detection sections may be

arranged at the center and four vertices of the
above-described square.

With this arrangement, independently of whether
the FPD having a 14" $\times$ 17" size is set in the portrait
5 mode or landscape mode, the AEC detection regions 51
can be located at optimum positions for chest/belly
part radiographing. Alternatively, an AEC detection
device having the radiographic image detection section
8 (photodetection pixel array) and AEC detection
10 sections separate from the radiographic image detection
section 8 is used. The radiographic image detection
section 8 and AEC detection sections are integrated
such that they are integrally rotated and moved. Even
in a radiographic apparatus that uses such an AEC
15 detection device, when the AEC detection sections are
arranged in the same way as described above with
respect to the radiographic image detection section 8,
the same effect as described above can be obtained.

In the radiographic apparatus having the above
20 arrangement, independently of whether the FPD is set in
the portrait mode or landscape mode, the AEC detection
region 51a at the center and the two AEC detection
regions 51b located above it (in the pulmonary parts in
Figs. 5A and 5B) are selected and used. For this
25 purpose, the radiographic apparatus according to this
embodiment includes a recognition section which
recognizes the relative arrangement relationship

between the subject and the radiographic apparatus (e.g., whether the device is set in the portrait mode or landscape mode), a control section which controls the radiation dose detection sections and AEC section

5   on the basis of the recognition result from the recognition section to selectively use some of the output signals from the plurality of radiation dose detection sections for AEC, and an AEC section which controls exposure of the radiation dose detection

10 sections on the basis of the output signals from the radiation dose detection sections selected by the control section.

The recognition section can include at least one of a detection section which detects the relative

15 positional relationship between the subject and the radiographic apparatus and an operation section with which the positional relationship is input or set by the user. When radiographing is to be executed while making, e.g., a human or animal as a subject maintain a

20 predetermined posture, the detection section can detect the relative positional relationship between the subject and the radiographic apparatus by detecting the posture (the direction, e.g., portrait or landscape) of the radiographic apparatus with a sensor (e.g., a photo

25 interrupter, switch, proximity sensor, or rotary encoder). When radiographing is to be executed while setting the posture of, e.g., a human or animal as a

subject in an arbitrary direction, the detection
section can detect the relative positional relationship
between the subject and the radiographic apparatus by
detecting the posture (direction) of the human or
5   animal through image sensing and image processing.

An arrangement example of the radiographic
apparatus will be described with reference to Fig. 6.

Referring to Fig. 6, a radiographic apparatus 60
includes a control section 61 including a CPU and the
10   like, a radiographic image detection section 62 similar
to the radiographic image detection section 8,
radiation dose detection sections 631 to 634 similar to
the radiation dose detection sections 51a and 51b, a
recognition section 64 which recognizes the relative
15   positional relationship (e.g., portrait or landscape)
between the subject and the radiographic apparatus, and
an AEC section 66 which controls exposure of the
radiographic image detection section 8 by using the
radiation dose detection sections decided by the
20   control section 61 in accordance with the recognition
result from the recognition section 64. These elements
are connected to be communicable through a CPU bus or a
network 65. As described above, the recognition
section 64 includes at least one of, e.g., a detection
25   section (not shown) which detects the relative
positional relationship between the subject and the
radiographic apparatus (radiographic image detection

section 62) and an operation section (not shown) with which the positional relationship is input or set by the user. The recognition section 64 can communicate with at least one of the detection section and

5   operation section.

In the above description, the radiographic apparatus is set in one of the portrait mode and landscape mode. In accordance with the use purpose of the radiographic apparatus, the radiographic apparatus

10   and/or the subject may assume various postures so that rotation for every arbitrary angle such as 45° in a predetermined plane may be permitted. In this case, the recognition section 64 can be designed to recognize the relative positional relationship between the

15   radiographic apparatus and the subject in correspondence with various postures. As the layout pattern of the radiation dose detection sections 631 to 634 with respect to the radiographic image detection section 62, a pattern in which when the radiographic

20   image detection section 62 is rotated by only a predetermined angle, e.g., 90° or less (e.g., 45° or 90°) in its radiographic image detection plane, the positions of all the radiation dose detection sections before rotation coincide with those after rotation (a

25   rotational symmetrical layout pattern in rotation of the predetermined angle) or a pattern in which the positions of some radiation dose detection sections

before rotation coincide with those after rotation is preferably used. An example of the latter pattern is shown in Figs. 5A and 5B.

The flow of processing of the control section 61

5   will be described with reference to the flow chart shown in Fig. 7.

First, in step S71, the control section 61 confirms the arrangement state of the radiographic apparatus, which is recognized by the recognition

10   section 64, as the relative positional relationship between the subject and the radiographic apparatus (radiographic image detection section 62).

In step S72, the use mode of the radiation dose detection sections 631 to 634 for AEC is decided on the

15   basis of the arrangement state confirmed in step S71. As the use mode, for example, at least which one of the radiation dose detection sections 631 to 634 is to be used to cause the AEC section 66 to control exposure of the radiographic image detection section 62, or how to

20   weight the output signals from the radiation dose detection sections 631 to 634 to cause the AEC section 66 to control exposure of the radiographic image detection section 62 can be decided.

In step S73, the control section 61 executes

25   radiographing by controlling the radiographic image detection section 62, radiation dose detection sections 631 to 634, and AEC section 66 on the basis of a

radiographing command from a user interface (not

shown), thereby acquiring the radiographic image data

of the object. In this radiographing, the AEC section

66 controls the exposure amount of the radiographic

5   image detection section 62 by using the output signals

from the radiation dose detection sections which are

decided in step S72 on the basis of the arrangement

state of the radiographic apparatus as the relative

positional relationship between the subject and the

10   radiographic apparatus (radiographic image detection

section 62).

(Other Embodiment)

     The object of the present invention can also be

achieved by supplying a storage medium which stores

15   software program codes for implementing the functions

of the apparatus or system according to the

above-described embodiment to the apparatus or system

and causing the computer (or a CPU or MPU) of the

apparatus or system to read out and execute the program

20   codes stored in the storage medium.

     In this case, the program codes read out from the

storage medium implement the functions of the

embodiment by themselves, and the storage medium which

stores the program codes and the program codes

25   constitute the present invention. As the storage

medium for supplying the program codes, a ROM, floppy

(trademark) disk, hard disk, optical disk,

magnetooptical disk, CD-ROM, CD-R, magnetic tape, nonvolatile memory card, or the like can be used.

The functions of the embodiment are implemented not only when the readout program codes are executed by the computer but also when the OS running on the computer performs part or all of actual processing on the basis of the instructions of the program codes.

The present invention also incorporates a case wherein the functions of the above-described embodiment are implemented when the program codes read out from the storage medium are written in the memory of a function expansion board inserted into the computer or a function expansion unit connected to the computer, and the CPU of the function expansion board or function expansion unit performs part or all of actual processing on the basis of the instructions of the program codes.

When the present invention is applied to the program or the storage medium that stores the program, the program is constituted by, e.g., program codes corresponding to the above-described flow chart shown in Fig. 7.

Fig. 8 is a block diagram showing the arrangement of a computer 1000. As shown in Fig. 8, the computer 1000 is constituted by connecting a CPU 1001, a ROM 1002, a RAM 1003, a keyboard controller (KBC) 1005 which executes control related to a keyboard (KB) 1009,

a CRT controller (CRTC) 1006 which executes control related to a CRT display (CRT) 1010 serving as a display section, a disk controller (DKC) 1007 which executes control related to a hard disk (HD) 1011 and a

5 flexible disk (FD) 1012, and a network interface controller (NIC) 1008 for connection to a network 1020 such that these elements can communicate with each other through a system bus 1004.

The CPU 1001 systematically controls the

10 respective components connected to the system bus 1004 by executing software stored in the ROM 1002 or HD 1011 or software supplied from the FD 1012. More specifically, the CPU 1001 executes control to implement the operation of the above-described

15 embodiment by reading out a processing program corresponding to a predetermined processing sequence from the ROM 1002, HD 1011, or FD 1012 and executing the program.

The RAM 1003 functions as the main memory or work

20 area of the CPU 1001. The KBC 1005 executes control related to instruction input from the keyboard 1009 or a pointing device (not shown). The CRTC 1006 executes control related to display of the CRT 1010.

The DKC 1007 executes control related to access

25 to the HD 1011 and FD 1012 which store boot programs, various applications, edited files, user files, network management programs, and predetermined processing

programs. The NIC 1008 executes two-way data communication with the apparatus or system on the network 1020.

The present invention can be applied to a system
5   constituted by a plurality of devices (e.g., a radiation generation device, radiographic apparatus, image processing apparatus, interface devices, and the like) or a single device in which the functions of these devices are integrated. When the present
10 invention is applied to a system constituted by a plurality of devices, the plurality of devices build a system through, e.g., an electrical, optical, and/or mechanical communication means.

Examples of the modes of the present invention
15 will be listed below.
[First Mode]

According to the first mode of the present invention, a radiographic apparatus having a radiographic image detection section which detects the
20 radiographic image of an object (subject) and a plurality of radiation dose detection sections which detect the dose of radiation from the object, comprises a control section which decides a mode of use of outputs from the plurality of radiation dose detection
25 sections on the basis of the relative positional relationship between the object and the radiographic apparatus (e.g., the arrangement state of the

radiographic apparatus).

[Second Mode]

According to the second mode of the present invention, the radiation dose detection sections can be

5   formed between the pixels of the radiographic image detection section.

[Third Mode]

According to the third mode of the present invention, the radiation dose detection sections may be

10 formed in a layer different from a layer where the pixels of the radiographic image detection section are formed.

[Fourth Mode]

According to the fourth mode of the present

15 invention, the radiographic image detection region of the radiographic image detection section can have a rectangle (excluding a square).

[Fifth Mode]

According to the fifth mode of the present

20 invention, the plurality of radiation dose detection sections can be arranged such that when the radiographic image detection section is rotated by only a predetermined angle (e.g., 90° or less) in the radiographic image detection plane, the positions of

25 all of the plurality of radiation dose detection sections before rotation coincide with those after rotation (i.e., the radiation dose detection sections

are rotationally symmetrical in rotation of the predetermined angle).

[Sixth Mode]

According to the sixth mode of the present

5   invention, the plurality of radiation dose detection sections can be arranged such that when the radiographic image detection section is rotated by only a predetermined angle (e.g., 90° or less) in the radiographic image detection plane, the positions of

10   some of the plurality of radiation dose detection sections before rotation coincide with those after rotation.

[Seventh Mode]

According to the seventh mode of the present

15   invention, the radiographic apparatus can further comprise a pivot mechanism which integrally pivots the radiographic image detection section and the plurality of radiation dose detection sections in the radiographic image detection plane of the radiographic

20   image detection section.

[Eighth Mode]

According to the eighth mode of the present invention, the radiographic apparatus can further comprise a recognition section which recognizes the

25   arrangement state.

[Ninth Mode]

According to the ninth mode of the present

invention, a radiographic method applied to a
radiographic apparatus having a radiographic image
detection section which detects the radiographic image
of an object and a plurality of radiation dose
5   detection sections which detect the dose of radiation
from the object, comprises a decision step of deciding
a mode of use of outputs from the plurality of
radiation dose detection sections on the basis of the
relative positional relationship between the object and
10   the radiographic apparatus (e.g., the arrangement state
of the radiographic apparatus).
[10th Mode]
     According to the 10th mode of the present
invention, a computer program which causes a computer
15   to execute a radiographic method applied to a
radiographic apparatus having a radiographic image
detection section which detects the radiographic image
of an object and a plurality of radiation dose
detection sections which detect the dose of radiation
20   from the object, comprises a decision step of deciding
a mode of use of outputs from the plurality of
radiation dose detection sections on the basis of the
relative positional relationship between the object and
the radiographic apparatus (e.g., the arrangement state
25   of the radiographic apparatus).
[11th Mode]
     According to the 11th mode of the present

invention, in a radiographic apparatus having a
radiographic image detection section which detects the
radiographic image of an object and a plurality of
radiation dose detection sections which detect the dose
5   of radiation from the object, the plurality of
radiation dose detection sections are arranged such
that when the radiographic image detection section is
rotated by only a predetermined angle (90° or less) in
the radiographic image detection plane, the positions
10 of all of the plurality of radiation dose detection
sections before rotation coincide with those after
rotation (i.e., the radiation dose detection sections
are rotationally symmetrical in rotation of the
predetermined angle).

15 [12th Mode]

    According to the 12th mode of the present
invention, in a radiographic apparatus having a
radiographic image detection section which detects the
radiographic image of an object and a plurality of
20 radiation dose detection sections which detect the dose
of radiation from the object, the plurality of
radiation dose detection sections can be arranged such
that when the radiographic image detection section is
rotated by only a predetermined angle (e.g., 90° or
25 less) in the radiographic image detection plane, the
positions of some of the plurality of radiation dose
detection sections before rotation coincide with those

after rotation.

As has been described above, according to the present invention, for example, automatic exposion control can appropriately be executed.

5   As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the

10   appended claims.